Single Season Multi-State Occupancy Case Study – Estimating Occupancy and Breeding Propensity of California Spotted Owls.

Project Description and Context

In this module, we shall fit models that use the multi-state (single-season) model using data from California spotted owls (*Strix occidentalis occidentalis*) collected in the central Sierra Nevada during the breeding season of 2004. The sampling situation involved searching for owls at potential territory sites (54 sites) and drawing inferences about the occupancy status of each site. We define 3 possible true states: 0=unoccupied, 1=occupied with no production of young, and 2=occupied with successful reproduction. At each visit to a site, the result of the site visit was classified into one of the following observation states: 0=no detection, 1=detection of the species with uncertain state assignment, and 2=detection of the species in state 2, with no uncertainty associated with state assignment.

The data are included in the sample data folder that is installed along with PRESENCE in the Excel spreadsheet **Cal_Owl_MultiState_data.csv**. This file consists of 1 sheet containing the detection data. In this example, detection histories are summarized, so the last column is a count of the number of sites which exhibited each detection history. (There are 40 detection histories in the input file, which represent 54 sites.)

References:

Nichols, J. D., Hines, J.E., MacKenzie, D.I., Seamans, M.E., and R.J. Gutierrez. 2007. Occupancy Estimation and Modeling with Multiple States and State Uncertainty. Ecology, 88(6): 1395-1400.

Exercise Objectives

- Learn how to create and run occupancy models with multiple states and state uncertainty
- Learn to import data and infestigate possible patterns of time variation
- Continue to increase comfort level and familiarity with all aspects of analysis in PRESENCE from data exploration to model selection, and interpretation of results

Presence spreadsheet data file: **Cal_Owl_MultiState_data.csv**

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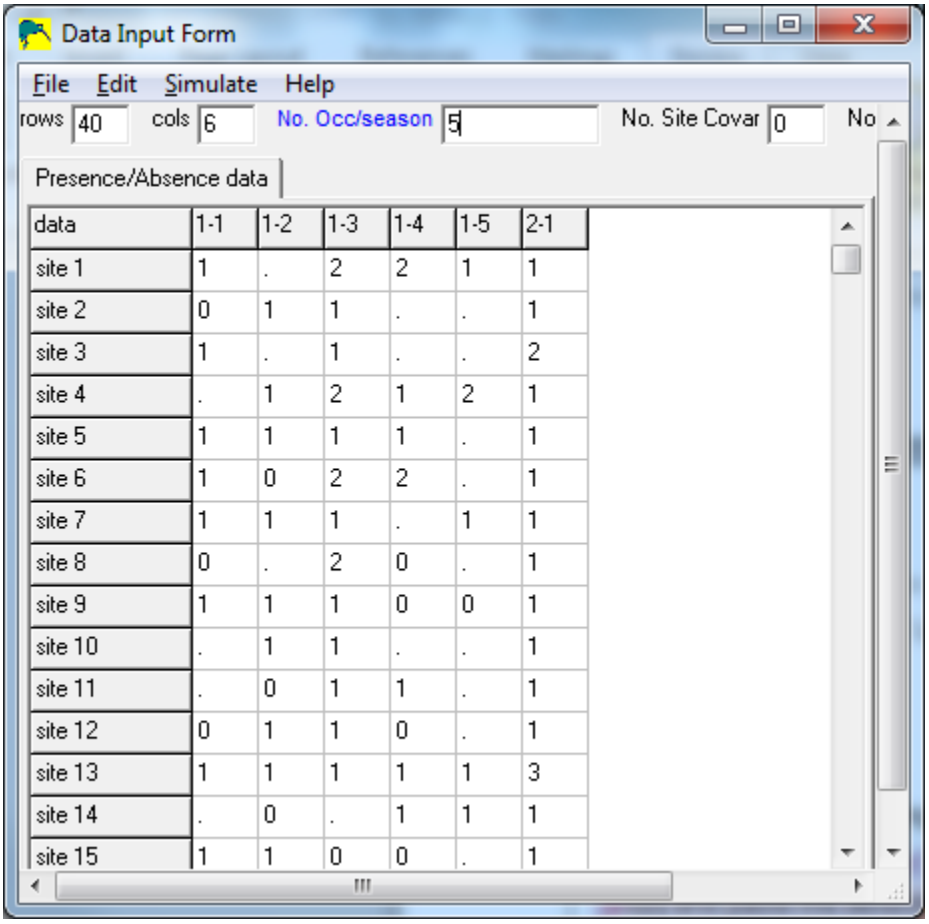
INSTRUCTIONS

Step 1 – Data Import: Begin PRESENCE, start a new project and open the data input form. Open the sample data file, Cal_Owl_MultiState_data.csv, in your favorite spreadsheet program, and copy and paste the detection-nondetection data from the spreadsheet into PRESENCE in the same manner as for the previous examples, changing the number of surveys per season to 5. (Since the last column will be used as a frequency, the '2-1' heading can be ignored.)



data	1-1	1-2	1-3	1-4	1-5	2-1
site 1	1	.	2	2	1	1
site 2	0	1	1	.	.	1
site 3	1	.	1	.	.	2
site 4	.	1	2	1	2	1
site 5	1	1	1	1	.	1
site 6	1	0	2	2	.	1
site 7	1	1	1	.	1	1
site 8	0	.	2	0	.	1
site 9	1	1	1	0	0	1
site 10	.	1	1	.	.	1
site 11	.	0	1	1	.	1
site 12	0	1	1	0	.	1
site 13	1	1	1	1	1	3
site 14	.	0	.	1	1	1
site 15	1	1	0	0	.	1

Save the data file using an appropriate name (I used 'CalOwl'), click 'Yes' to indicate that the spreadsheet contains site frequencies, then close the data input form which will return you to the **Enter Specifications for PRESENCE Analysis** window. Select the data file you have just created, add a title for the project, then click 'OK'. After a couple of seconds a blank results browser should appear. Remember, if you do not see the results browser, you have not successfully set up your project file.

Step 2 – Data Exploration:

Bring back the Data window (**View>Data**) and notice that some sites contain 2's, indicating that breeding was detected at the site, and some sites only contain 1's and 0's. Just as sites with all zeros may be occupied, sites with only 0's and 1's may be breeding sites. These data were analyzed before multiseason models were added to PRESENCE, so detection history records were summarized. Although this is allowed in PRESENCE, this method of input makes the addition of covariate data more difficult as all sites represented by the detection history and frequency count must have the same covariates.

Step 3 – Running a simple model : First, let's fit a simple model where the probability of occupancy and breeding are the same for all plots and the probability of detection and probability of detecting breeding activity are the same in all surveys. In our earlier notation we could call this model **psi(.)R(.)p(.)delta(.)**. The design matrix for occupancy will now contain 2 rows with 1's on the diagonal (occupancy different from breeding probability). The detection design matrix will contain 5 rows and 1 column (detection constant over the 5 surveys), and the classification probability (delta) will contain 5 rows and 1 column. After the design matrix appears you just need to hit 'Ok to Run' then confirm the results to add them to the results browser.

Exercise:

1. Working in small groups, fit the following models:
    a. Ψ(.)R(.)p(.)δ(1-2,3-5)
    b. Ψ(.)R(.)p(t)δ(1-2,3-5)
    c. Ψ(.)R(.)p(s)δ(1-2,3-5)
    d. Ψ(.)R(.)p(.)δ(.)
    e. Ψ(.)R(.)p(t)δ(.)
    f. Ψ(.)R(.)p(s)δ(.)

    Note: p(s) -> p varies by 'state'(non-breeding or breeding).

2. Calculate the summed AIC weights for models with/without the restricted time effect on delta.

3. Is there support for the hypothesis about the difficulty in detecting breeding during the first two surveys?